conditions), and (2) multi-point design (simultaneous design at the three flight conditions via a composite objective function). The single-point approach produced the bulk of the performance benefits, lowering the weighted-composite required thrust by 4.28 counts after trimming the full configuration at the three design points. (A 7.0 count drag reduction was achieved at cruise for the vehicle without trimming surfaces.) The sequential and multi-point methods achieved 6.03 and 7.55 counts of thrust reduction, respectively. These performance gains are significant, since a single drag count reduction at cruise reduces the takeoff weight of current designs by approximately 8,000 pounds.

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Resound Microphone Wind Noise Reduction

Clifton Horne, Paul T. Soderman

ReSound Corp. in Redwood City, California, has developed a miniature, ear-mounted, hands-free, microphone/receiver for use by technicians, police, firefighters, or others who need an unobtrusive communication system. When used in the field, however, wind-induced noise tended to mask voice communication. A foam covering reduced the noise, but was bulky and obtrusive. Through a Reimbursable Space Act Agreement, ReSound collaborated with the Experimental Physics Branch personnel to mitigate the wind-induced noise without resorting to bulky foam coverings.

To achieve the objective, an artificial head was installed in a ducted fan flow in the AIP acoustics laboratory (figure 1), and a series of experiments was conducted on wind-induced noise of the baseline ReSound microphone over a 3-month period. Using technology developed at Ames for measurement of aircraft model noise in wind tunnels, a screen-covered forebody was designed that protected the microphone sensor yet conformed to the shape and size of the ear-mounted device (figure 2). The forebody had an aerodynamic shape to minimize flow perturbations; the screen inhibited unsteady pressures at the sensors while passing sound waves. New information was acquired on the baseline and on improved microphone designs regarding effects of turbulence, wind speed, head-tilt angle, and yaw angle. The fluid-mechanic sources of wind noise were isolated. Turbulence, airspeed, and noise were measured in the fan flow, in the free-wind outdoors, in a moving truck in calm air, and in the low turbulence 7- by 10-foot wind tunnel. Results showed that the new wind screen gave improved noise reduction

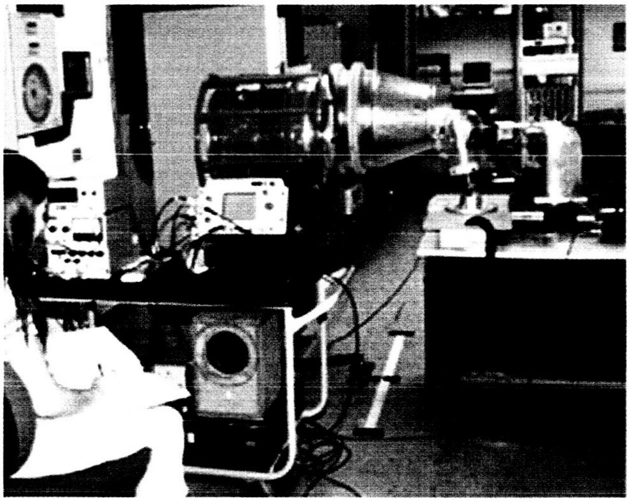

Fig. 1. Experimental set-up in acoustic lab with artificial head model, wind simulator, and instrumentation for measuring flow characteristics and microphone noise.

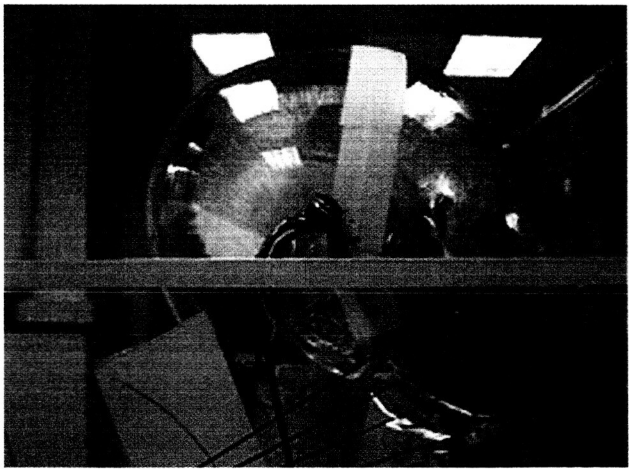

Fig. 2. Close-up detail of artificial head model with ear-mounted microphone and alignment template.

relative to the ReSound baseline with foam covering and that it has a more robust, streamlined shape that lends itself to unobtrusive operation by the user. Microphone response was carefully correlated with flow parameters such as turbulence, airspeed, and flow angle so that future changes can be evaluated using the database.

Further improvements in the design may be possible by optimizing the screen impedance and the forebody shape.

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Stealth Technology Reduces Airframe Noise

Paul T. Soderman

Recent airframe noise studies at Ames Research Center and elsewhere have identified flap side-edge noise as an important component of aircraft landing noise. During aerodynamic tests of an Air Force stealth fighter design (called SHARC) in the Ames 40- by 80-Foot Wind Tunnel, it came to our attention that stealth technology might have acoustic attributes. Specifically, the Continuous Moldline Technology (CMT) developed for SHARC eliminates flap side edges by blending the flap and wing trailing edges with a flexible material that is load bearing. This led to a 7- by 10-foot wind tunnel aeroacoustic test of a two-dimensional airfoil with a simple hinged flap with and without a CMT modification (figure 1).

To investigate CMT performance, a 70-element phased microphone array technology (PMAT) acoustic system was installed in the Ames 7- by 10-Foot Wind Tunnel test section wall. The array is designed for visualization of noise sources and determination of their individual strengths. Noise radiation from the vertically mounted wing/flap model revealed a virtual elimination of the side-edge noise in the flyover direction. Because of the large noise reduction, it was necessary to recess the microphones in order to reduce flow-induced noise and increase the signal-to-noise ratio. A strong Kevlar cloth covered the recess. With this array geometry, noise levels that were 20 decibels below the wind tunnel background noise could be identified.

With the new array, it was found that the CMT flap was at least 6–8 decibels quieter than the simple hinged flap, as shown by the phased array images of figure 2. Background noise made it impossible to identify noise sources below that level. Previous work indicates that the simple hinged flap is quieter than the conventional Fowler flap used on current air transports. Hence, new aircraft designs such as the Blended Wind Body, which can operate with a simple high lift system, would benefit from the low noise of simple hinged or CMT flap systems. Aerodynamic performance data were acquired simultaneously with the acoustic data.

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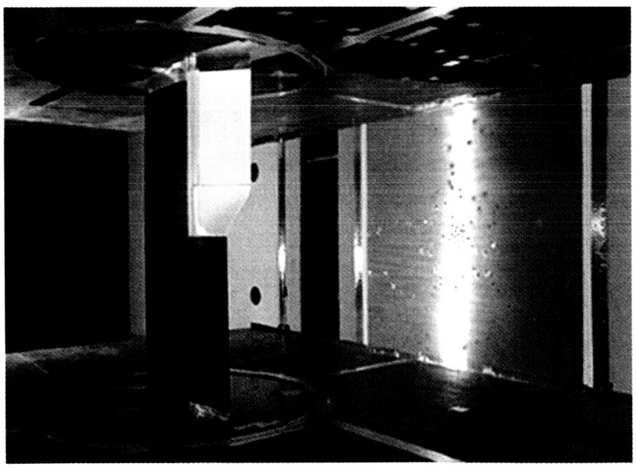

Fig. 1. Upstream view of airfoil model with simple flap (upper white) blended to wing by CMT section. Phased microphone array is mounted on test section right wall.